PATENT SPECIFICATION

Convention Date (United States): May 20, 1937. **491,301**

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Complete Specification Accepted: Aug. 30, 1938.

COMPLETE SPECIFICATION

Improvements in and relating to Moving Stairways

We, WAYGOOD-OTIS LIMITED, a British Joint-Stock Company, of Falmouth Road, London, S.E.1, England, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

The invention relates to moving stairways.

Moving stairways comprise an endless series of steps which are moved from one landing to another for the purpose of conveying passengers. The steps are connected together by means of sprocket chain, known as running gear chain. It has been the practice for a considerable number of years to provide a running gear chain on each side of the stairway and to drive these chains by means of sprocket wheels at the upper end of the stairway. The steps are supported on each side by wheels which run on tracks. Sprocket wheels may be provided at the lower end of the stairway for the chains to carry the steps around the bend or the steps may be supported in passing around the bend solely by curved tracks for the supporting wheels of the steps. It is desirable that moving stairways operate as smoothly and noiselessly as possible. Many improvements have been made with the view of aiding in accomplishing this purpose. One of the problems has been the bringing of the steps smoothly and noiselessly around the bends at the ends of the stairway.

The object of the invention is to eliminate noise incident to the transfer of the steps from one run to the other at the ends of the stairway.

The invention involves the provision of a plurality of wheels for each step and a track system having a continuous track for each wheel, and maintaining all of these wheels at all points in the travel of the step in contact with their tracks. Several arrangements will be described as illustrative of modes of carrying out the invention. In each arrangement described, each step is provided on each side with two wheels, one of which is associated with the running gear chain. Continuous tracks are provided for these wheels. Each step is provided with one additional wheel common to the two sides of the stairway or with two additional wheels, one for each side of the stairway. A continuous track is provided for each additional wheel. Each additional wheel is mounted for relative movement with respect to the other wheels, a resilient connection being provided between the additional wheel and the step for exerting a force between the additional wheel and the other wheels which acts to maintain all the wheels in engagement with their tracks at all times.

As another aspect of obtaining quiet operation of the stairway as the steps pass around an end of the stairway at which the chains mesh with sprocket wheels, sound deadening material is utilized to deaden the sound of contact of the rollers of the running gear chains with the teeth of the sprocket wheels.

Features and advantages of the invention will be apparent from the following description and appended claims.

In the drawings:—

Figure 1 is a diagrammatic representation in side elevation of a moving stairway showing one arrangement for maintaining the wheels of the step in continuous engagement with their tracks;

Figure 2 is an enlarged rear view of one of the steps of the moving stairway of Figure 1;

Figure 3 is a view taken along the line 3—3 of Figure 2;

Figure 4 is a diagrammatic representation in side elevation of a moving stairway showing another arrangement for maintaining the wheels of the step in continuous engagement with their tracks;

Figure 5 is an enlarged rear view of one of the steps of the moving stairway of Figure 4;

Figure 6 is a view taken along the line 6—6 of Figure 5;

Figure 7 is a diagrammatic representation in side elvation of a moving stairway showing another arrangement for maintaining the wheels in continuous engagement with their tracks;

Figure 8 is an enlarged rear view of one of the steps of the moving stairway of Figure 7;

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Figure 9 is a view taken along the line 9—9 of Figure 8;

Figure 10 is an enlarged fragmental detail showing one arrangement of employing sound deadening material to deaden the noise of contact of chain rollers with a sprocket wheel;

Figure 11 is an enlarged fragmental detail showing another arrangement of employing sound deadening material to deaden the noise of contact of chain rollers with a sprocket wheel; and

Figure 12 is a detail in section taken along the line 12—12 of Figure 11.

In each of the arrangements illustrated, the stairway comprises an endless series of steps 10 driven at the upper end of the stairway by means of sprocket wheels through running gear chains, a sprocket wheel and chain being arranged on each side of the stairway. A sprocket wheel 11 and running gear chain 12 are illustrated for one side of the stairway. The sprocket wheels are mounted on and driven by the main drive shaft 15, driven in turn by driving mechanism (not shown).

Referring to Figures 1, 2 and 3, each step comprises a step frame 16 upon which the tread 17 is mounted. The frame is mounted on elongated brackets 18, one on each side of the stairway, extending underneath the frame. A chain wheel 20 and a trailer wheel 23 is provided for each step on each side thereof. The chain wheels are mounted on an axle 21 extending across the stairway through opposite chain links in the running gear chains, the chain wheels being outside the links of the chains. The axle is supported by bearings 19 in the brackets. Each of the trailer wheels 23 for the step is mounted on a stub axle 24 supported by the other end of the step bracket 18.

A track 22 is provided on each side of the stairway for the chain wheels. A track 25 is also provided on each side of the stairway for the trailer wheels. Each of these tracks comprises an upper run portion and a return run portion joined at the ends by curved end portions to form a continuous track. These tracks are positioned and shaped to give the proper position to the steps at the various points in their travel. Mechanism is provided for maintaining the wheels in continuous contact with their tracks, without which the wheels, in passing around the bend from the upper run to the return run at an end of the stairway, would leave their tracks and would remain off the track until the transition from the return run to the upper run is made at the other end of the stairway.

In the form illustrated in the figures being described, this mechanism comprises fo reach step an additional wheel 26, a track 27 for this wheel and a spring 28 acting oppositely on the additional wheel and the chain and trailer wheels to exert the forces maintaining these wheels on their respective tracks. The track 27 for the additional wheel is arranged intermediate the sides of the stairway and is shaped to maintain the same relative positions of the wheels regardless of where the step may be in its travel. The additional wheel runs on the inside of its track as distinguished from the chain and trailer wheels, which run on the outside of their tracks.

The additional wheel 26 is supported on a stub shaft 29 carried by an arm 30 of lever 31. This arm forms an extension at right angles from a **U**-shaped portion 32 which is pivotally mounted on axle 21 between brackets 18. A channel shaped member 33 extends between the brackets and is apertured at 34 to slidably receive a stud 35. This stud is secured to the yoke 36 of the **U**-shaped portion 32 by lock nut 37. The spring 28 is arranged on the stud and is held in a state of compression between the channel member 33 and a washer 38 on the outer end of the stud by adjustable lock nuts 40. Lever 31 is constructed so as to locate wheel 26 intermediate the chain and trailer wheels as viewed in Figure 3. Likewise the channel shaped member 33 is intermediate these wheels. As spring 28 is in a state of compression, it acts through washer 38, nuts 40 and stud 35 to exert a force to maintain wheel 26 in engagement with its track surface. In so doing the spring acts through channel member 33 and brackets 18 to exert a force to maintain the chain and trailer wheels on their respective track surfaces. The channel member 33 being intermediate these wheels, causes this force to be exerted equally on the chain and trailer wheels. With this construction, the wheels are maintained in rolling engagement with their respective track surfaces regardless of the position of the step in its travel, as may be seen from Figure 1, in which the steps are illustrated at various points of step travel. Thus any noise incident to the wheels passing around the bends at the ends of the stairway is eliminated.

It is preferred not to provide rollers in the running gear chain where the chain wheel axles extend through the chain. This obviates any noise incident to meshing of chain wheel rollers with the sprocket wheels which might otherwise occur, particularly after wear of the chain wheels as taken place. Also, a certain amount of clearance is provided between lock nut 37 and channel member 33. This

insures spring 28 being effective to maintain the wheels on their respective tracks after wear of the wheels has taken place.

Referring now to the arrangement shown in Figures 4, 5 and 6, the step frame is mounted on brackets 45, one on each side of the stairway. Each of these brackets is formed with a cross member 49 and an arm 51, somewhat in the nature of a T except that the arm is at an acute angle to the cross member in the direction of movement of the stairway while ascending. A wheel 46 is provided for each step on each side thereof. These wheels are mounted on an axle 47 extending across the stairway, preferably midway of the step tread. This axle extends through opposite chain links in the running gear chains, the wheels being outside the links of the chain. The axle is supported by bearings 44 in the cross members 49 of the brackets. The wheels 46, being associated with the chains, will be termed chain wheels.

In addition to the chain wheels, each step is provided on each side thereof with two additional wheels. One of these wheels, designated 48, is mounted on a stub axle 50 supported by the end of arm 51 of bracket 45. The other wheel, designated 52, is mounted on a stub axle 53 supported by the end of a lever 54 pivotally mounted on axle 47 between bracket 45 and the running gear chain. The lever 54 is arranged at an angle to arm 51 of bracket 45 as indicated in Figure 6.

A track 55 is provided on each side of the stairway for the chain wheels. A track 56 is also provided on each side of the stairway for the bracket wheels 48. Likewise, a track 57 is provided on each side of the stairway for wheels 52. Each of these tracks comprises an upper run portion and a return run portion joined at the ends by curved end portions to form a continuous track. The chain wheels run on the outside of their tracks, whereas wheels 48 and 52 run on the inside of their tracks. The tracks are positioned and shaped to give the proper position to the steps at the various points in their travel. In the construction illustrated, the track surface for wheels 52 on each side of the stairway may be aligned with that for wheels 48 for the inclined portion of the upper run of the stairway, as illustrated in Figure 4. If desired, the construction may be such that for this portion of the run a common widened track may be used on each side of the stairway.

The wheels of each step are maintained on their respective track surfaces by means of springs 60, one on each side of the stairway. The construction for each side of the stairway is the same. The spring is a compression spring and is positioned between oppositely disposed lugs 61 and 62 provided on lever 54 and arm 51 respectively. The spring is arranged on a stud 63 threaded into an aperture in lug 61 and secured thereto by a lock nut 64. The stud slidably extends through an aperture 65 provided in the other lug 62. Lock nuts 66 on the outer end of the stud limit the amount of spread of the wheels.

As spring 60 is in a state of compression, it acts through the lugs to exert a force to maintain wheels 48 and 52 in engagement with their respective track surfaces. In so doing, it spreads the lever 54 and arm 51 of the bracket apart to draw the chain wheel 46 into engagement with its track surface. Thus, with this construction also, the wheels of the step are maintained in rolling engagement with their respective track surfaces, regardless of the position of the step in its travel, as may be seen from Figure 4, so that any noise incident to the wheels passing around the bends at the end of the stairway is eliminated.

In this arrangement also it is preferred to omit the rollers in the running gear chain where chain wheel axles extend through the chain, to obviate noise incident to the meshing of chain wheel rollers with the sprocket wheels. Also, a certain amount of clearance is provided between lock nuts 66 and lugs 62 to insure springs 60 being effective to maintain the wheels on their tracks after wear of the wheels has taken place. It is preferred to employ springs that are strong enough to maintain the wheels on their track surfaces when the weight on the step is concentrated on the right hand side of the tread as viewed in Figure 6.

Referring now to the arrangement shown in Figures 7, 8 and 9, the step frame is mounted on brackets 70, one on each side of the stairway. Each of these brackets has a portion 67 extending beneath the step frame and an angular portion depending therefrom and having two arms 68 and 69, thereby forming a triangle, arm 69 being at an acute angle to portion 67 in the direction of movement of the step while descending. A wheel 71 is provided for each step on each side thereof. These wheels are mounted on an axle 72 extending across the stairway, preferably midway of the step tread. This axle extends through opposite chain links in the running gear chains and the wheels are outside the links of the chain. The axle is supported by bearings 78 in the brackets at the point of junction of arms 68 and 69. These wheels, being associated with the chains, will also be termed chain wheels.

In addition to the chain wheels, each step is provided on each side thereof with two additional wheels. One of these wheels, designated 73, is mounted on a stub shaft 74 supported by the upper end of the bracket as viewed in Figure 9. The other wheel, designated 75, is mounted on a stub shaft 76 supported by a lever 77 pivotally mounted on axle 72 between bracket 70 and the running gear chain. Lever 77 is at an angle to arm 69 of the bracket. With this arrangement, the wheels 73 and 75 are outside the chain and chain wheels, whereas in the arrangement of Figures 4, 5 and 6 the wheels 48 and 52 are inside the chain and chain wheels.

A track 80 for the chain wheels, a track 81 for wheels 73 and a track 82 for wheels 75 are provided on each side of the stairway. Each of these tracks comprises an upper run portion and a return run portion joined at the ends by curved end portions to form a continuous track. The chain wheels run on the outside of their tracks whereas wheels 73 and 75 run on the inside of their tracks. The tracks are positioned and shaped to give the proper position to the steps at the various points in their travel. As in the arrangement of Figures 4, 5 and 6, the track surface for wheel 73 on each side of the stairway may be aligned with that for wheel 75 for the inclined portion of the upper run of the stairway, as illustrated in Figure 7. If desired, the construction may be such that for this portion of the run a common widened track may be used on each side of the stairway.

The wheels of each step are maintained on their respective track surfaces by means of springs 85, one on each side of the stairway. The construction for each side of the stairway is the same. The spring is a tension spring and is secured at one end to a pin 86 secured to bracket 70 near stub shaft 74 and at the other end to the lever 77 near the stub shaft 76. As the spring is in a state of tension, it acts to exert a force to maintain wheels 75 and 73 on their respective track surfaces. In so doing, it pulls lever 77 and arm 69 of the bracket toward each other to push the chain wheel 71 into engagement with its track surface. Thus, with this construction also, the wheels of the step are maintained in rolling engagement with their respective track surfaces regardless of the position of the step in its travel, as may be seen from Figure 7, so that any noise incident to the wheels passing around the bends at the ends of the stairway is eliminated.

In this arrangement also it is preferred to omit the rollers in the running gear chain where the chain wheel axles extend through the chain, to obviate noise incident to the meshing of the chain wheel rollers with the sprocket wheels. Inasmuch as springs 85 are tension springs, they remain effective to maintain the wheels on their respective track surfaces after wear of the wheels has taken place. It is preferred to employ springs that are strong enough to maintain the wheels on their track surfaces when the weight on the step tread is concentrated on the right hand side of the tread as viewed in Figure 9.

In the arrangement of Figures 1, 2 and 3, a pair of wheels for each step, one on each side of the stairway, each mounted on a separate lever and having a separate spring for acting between it and the chain and trailer wheels on that side of the stairway, may be employed in lieu of wheel 26, lever 31 and spring 28, common to both sides of the stairway. Likewise, one wheel, lever and spring, common to both sides of the stairway, may be employed for each step instead of the wheel 52, lever 54 and spring 60 of Figures 4, 5 and 6 or the wheel 75, lever 77 and spring 85 of Figures 7, 8 and 9 for each side of the step. It is to be understood that other arrangements may be provided to cause all of the wheels of the step to be maintained on their tracks at all points in their travel. Also, the invention may be applied to other forms of moving stairway construction, that shown being chosen for convenience of illustration. In other words, the construction of the track system and the mechanism for maintaining the wheels of the step on their track surfaces may be arranged to suit the particular installation. Not only does the maintaining of all the wheels of the step on their tracks improve the operation of the stairway from the standpoint of quietness in operation but also minimizes wear of the wheels.

For the purpose of further improving the quietness of operation as the steps pass around an end of the stairway at which the chains mesh with sprocket wheels, sound deadening material may be employed to deaden the sound of contact as meshing of the chain rollers with the sprocket wheels takes place. Arrangements of this character are disclosed in Figures 10, 11 and 12. In the arrangement of Figure 10, the sides and bottom of the grooves between the teeth of the sprocket wheel are faced with sound deadening material, whereas in the arrangement of Figures 11 and 12 the chain rollers are provided with tires of sound deadening material. Various sound deadening materials may be employed for

this purpose. Rubber has been illustrated. The rubber is preferably secured to the sprocket wheel or chain rollers by vulcanizing. Synthetic rubber is particularly suitable owing to the fact that the wheels of the step are subject to oil. With either arrangement, as the chain runs on to the sprocket wheels, the chain rollers, in meshing with the sprocket wheel, are seated silently in the grooves between the teeth of the sprocket wheel so that any noise incident to the meshing of these rollers with the sprocket wheel is eliminated. In each of these figures, the rollers of the chain where the chain wheel axles extend through the chain have been omitted. It is to be understood, however, that rollers may be provided at this point if desired, particularly where sound deadening material is employed.

Having now particularly described and ascertained the nature of our said invention and in what manner the same is to be performed, we declare that what we claim is:—

1. A moving stairway comprising a series of steps connected together by a running gear chain, each step having a plurality of wheels, including a chain wheel, mounted upon wheel mounting means connected to said step, a track system providing track surfaces for the respective wheels for guiding them during movement of the stairway, and resilient means for each step acting through said mounting means for such step to exert forces on all of said wheels respectively in a direction to maintain them on their respective track surfaces at all points of step travel.

2. A moving stairway as claimed in claim 1, characterized in that said track system comprises one continuous track for each of said wheels.

3. A moving stairway as claimed in claim 2, characterized in that at least one wheel of each step engages with the outer surface of its continuous track and that at least one other wheel engages with the inner surface of its continuous track.

4. A moving stairway as claimed in claim 3, characterized in that the wheel engaging the outer surface of its continuous track is the chain wheel.

5. A moving stairway as claimed in any of the preceding claims, characterized in that said wheels are respectively mounted upon said wheel mounting means through the intermediary of axles supported upon said wheel mounting means.

6. A moving stairway as claimed in claim 5 in which the axle for the chain wheel passes through links of said chain.

7. A moving stairway as claimed in any of the preceding claims, characterized in that said plurality of wheels on each step comprises two wheels with their axes stationary with respect to each other and a third wheel with its axis movable relatively to the other wheels.

8. A moving stairway as claimed in claim 7, characterized in that said relatively movable wheel is mounted on a lever which is pivotally suported by the wheel mounting means for that step, said resilient means acting between said lever and said mounting means.

9. A moving stairway as claimed in claim 8, characterized in that said lever is pivotally mounted on said mounting means at a point closer to the chain wheel than the other of said relatively fixed wheels.

10. A moving stairway as claimed in claims 5 and 9, characterized in that said lever is pivotally mounted on the axle of said chain wheel.

11. A moving stairway as claimed in claim 5 and any of the claims 8—10, characterized in that said resilient means comprises a compression spring acting between said lever and a point on said wheel mounting means intermediate the axles of said relatively stationary wheels.

12. A moving stairway as claimed in any of the claims 8—10, characterized in that said relatively stationary wheels comprise said chain wheel and a second wheel.

13. A moving stairway as claimed in claim 12, characterized in that when the step is on the incline of the upper run of the stairway the two relatively stationary wheels of each step are mounted underneath the step, said second wheel being mounted below the chain wheel and toward the top of the stairway from said chain wheel and said lever extends below the step in such direction that said third wheel is toward the bottom of the stairway from the said second wheel for said step, said resilient means acting between said lever and said mounting means to maintain the wheel carried by said lever and said second wheel on their respective tracks and in so doing to exert a pulling force on said chain wheel in a direction towards its track.

14. A moving stairway as claimed in claim 12, characterized in that when the step is on the incline of the upper run of the stairway, the two relatively stationary wheels of each step are mounted underneath the step, said second wheel being mounted above the chain wheel and toward the top of the stairway from said chain wheel and said lever extends in such a direction that said third wheel is above the chain wheel and toward the bottom of the stairway from both the chain wheel and the second wheel for that step, said

resilient means comprising a tension spring acting between said mounting means and said lever to pull said second and third wheels toward each other to maintain said wheels on their respective tracks and in so doing exert a pushing force on said chain wheel in a direction toward its track.

15. A moving stairway as claimed in claim 13 or 14, characterized in that said chain wheel rolls on the outer surface of its continuous track and the second and third wheels roll on the inside surfaces of their respective tracks.

16. A moving stairway as claimed in any of the claims 7—15 in which a running gear chain is provided on each side of the stairway, characterized in that said two relatively stationary wheels are also mounted on each side of the stairway for each step at least one relatively movable wheel and at least one resilient means being provided for each step.

17. A moving stairway as claimed in claim 16, characterized in that a relatively movable wheel is provided on each side of the stairway for each step.

18. A moving stairway as claimed in claim 17, characterized in that resilient means is provided at each side of the stairway for each step for respectively exerting forces on all of the wheels at the two sides of the stairway for each step respectively directed toward the track surfaces of said wheels at all points of step travel.

19. A moving stairway as claimed in any of the preceding claims in which each running gear chain is driven by a sprocket wheel at an end of the stairway and in which the axles for the chain wheels pass through certain links of said chain, characterized in that each running gear chain is provided with rollers between the links on the pins joining the links but not on the axles for said chain wheels, the chain being supported at these points when in mesh with the sprocket wheel by said chain wheels rolling on the curved end portion of their track at the end of the stairway at which said sprocket wheel is located.

20. A moving stairway as claimed in any of the preceding claims in which each running gear chain is driven by a sprocket wheel at an end of the stairway, characterized in that sound deadening material is provided on one of the surfaces of contact of the chain rollers with the teeth of the sprocket wheel to deaden the sound of contact of the rollers with the sprocket wheel as the chain meshes therewith.

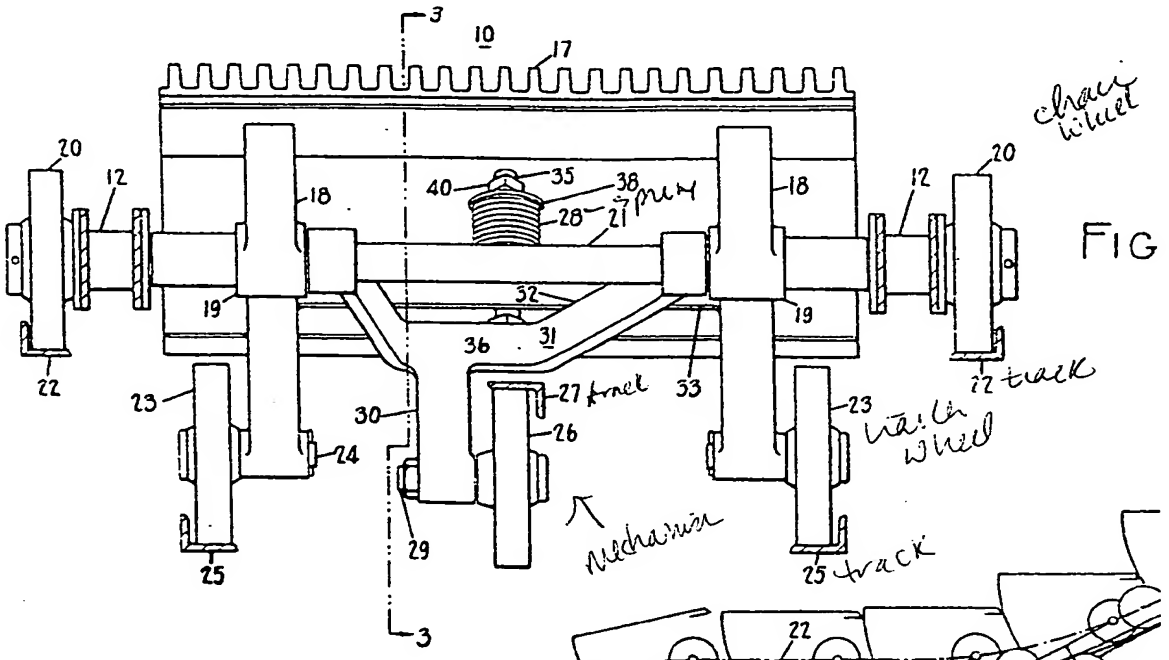
21. A moving stairway as claimed in claim 20, characterized in that said sound deadening material comprises a rubber facing on the roller contacting surfaces of the teeth of said sprocket wheel.

22. A moving stairway as claimed in claim 1 substantially as described with reference to the accompanying drawings.

Dated this 17th day of March, 1938.

MARKS & CLERK.

Leamington Spa: Printed for His Majesty's Stationery Office, by the Courier Press.—1938.



FIG

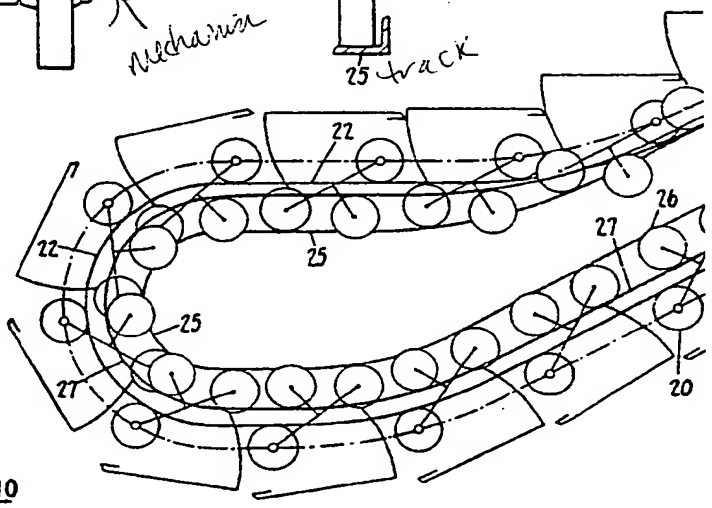
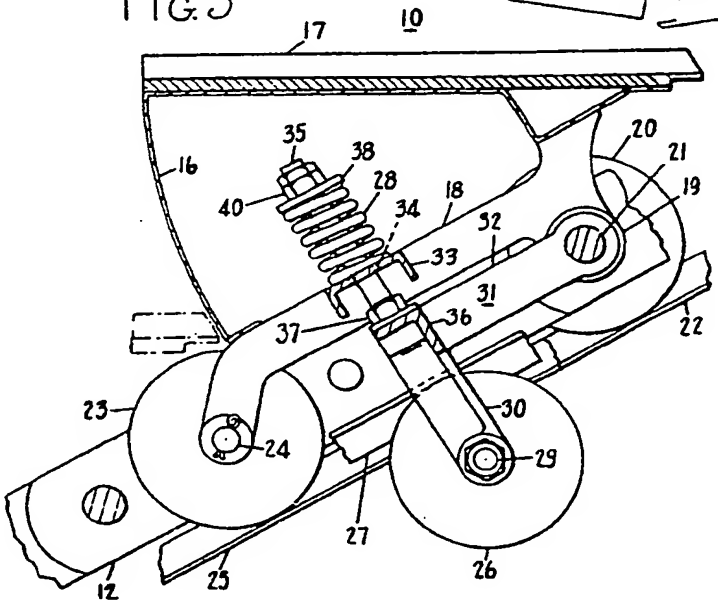


FIG. 3



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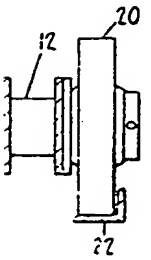
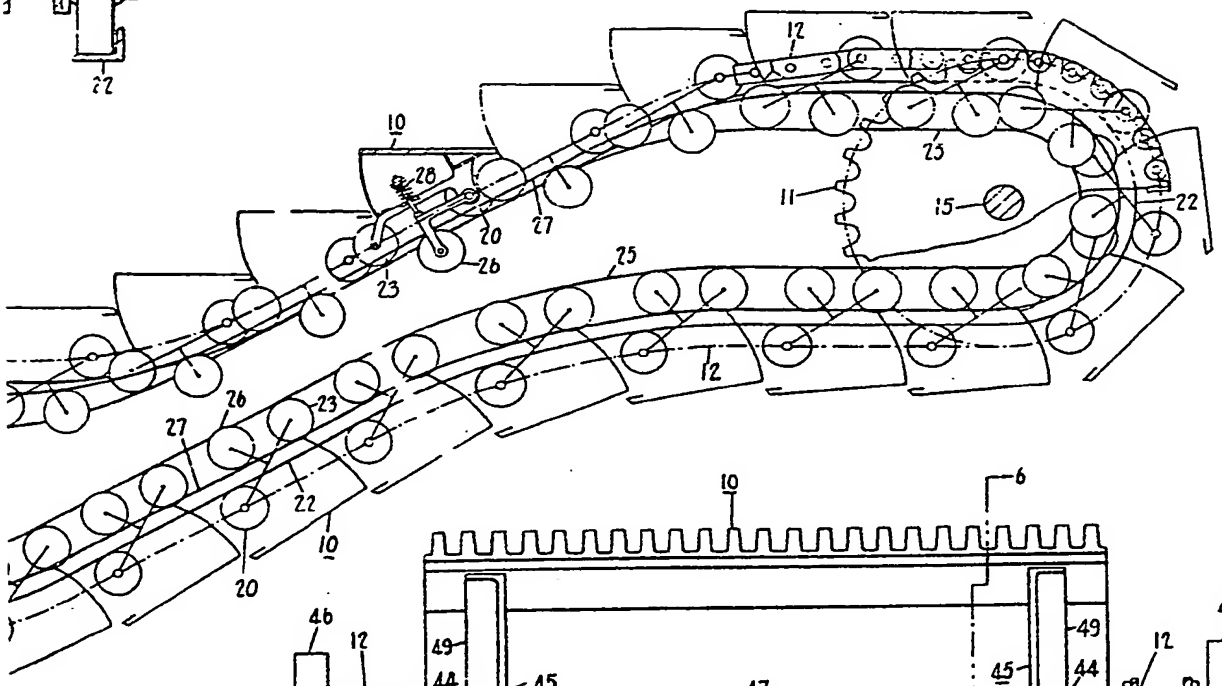


FIG. 2

FIG. 1



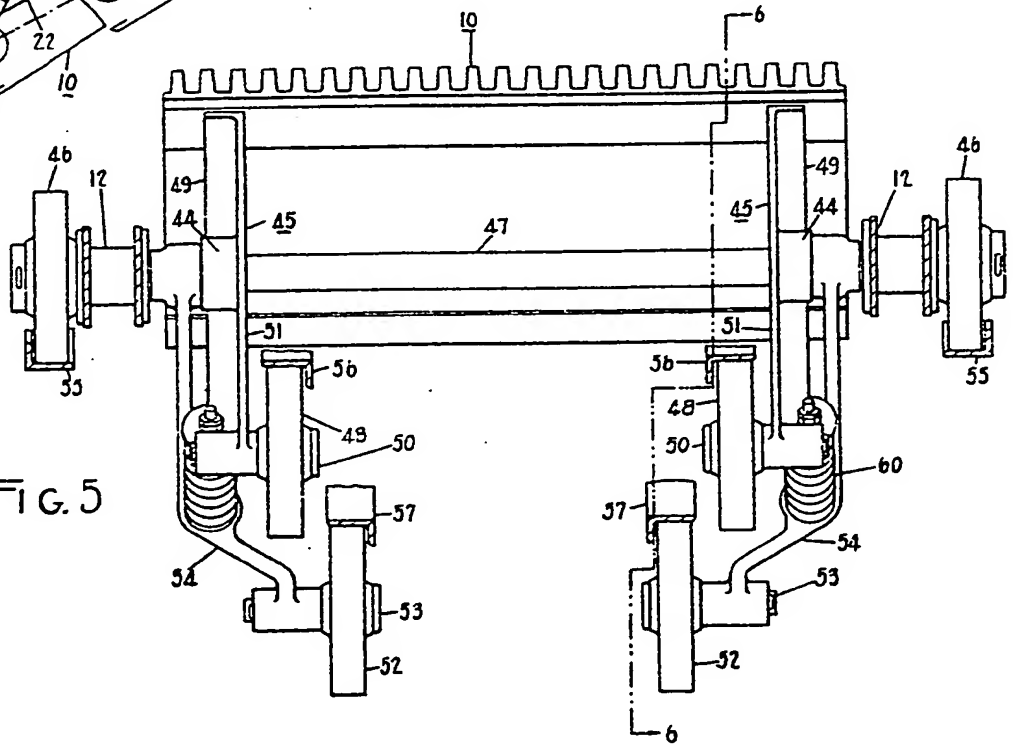


FIG. 5

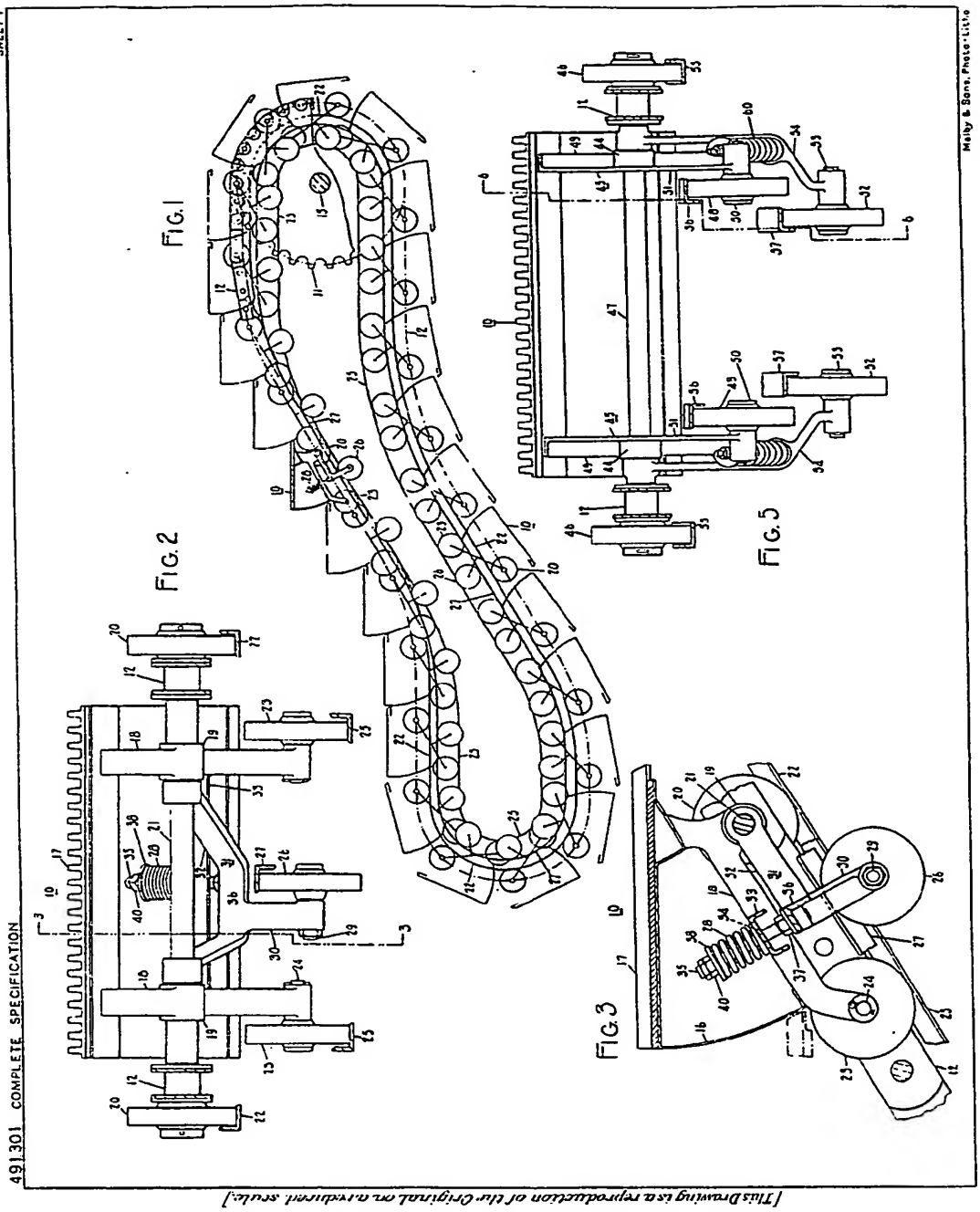


FIG. 1

FIG. 2

FIG. 3

FIG. 5

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[This Drawing is a reproduction of the Original on a reduced scale.]

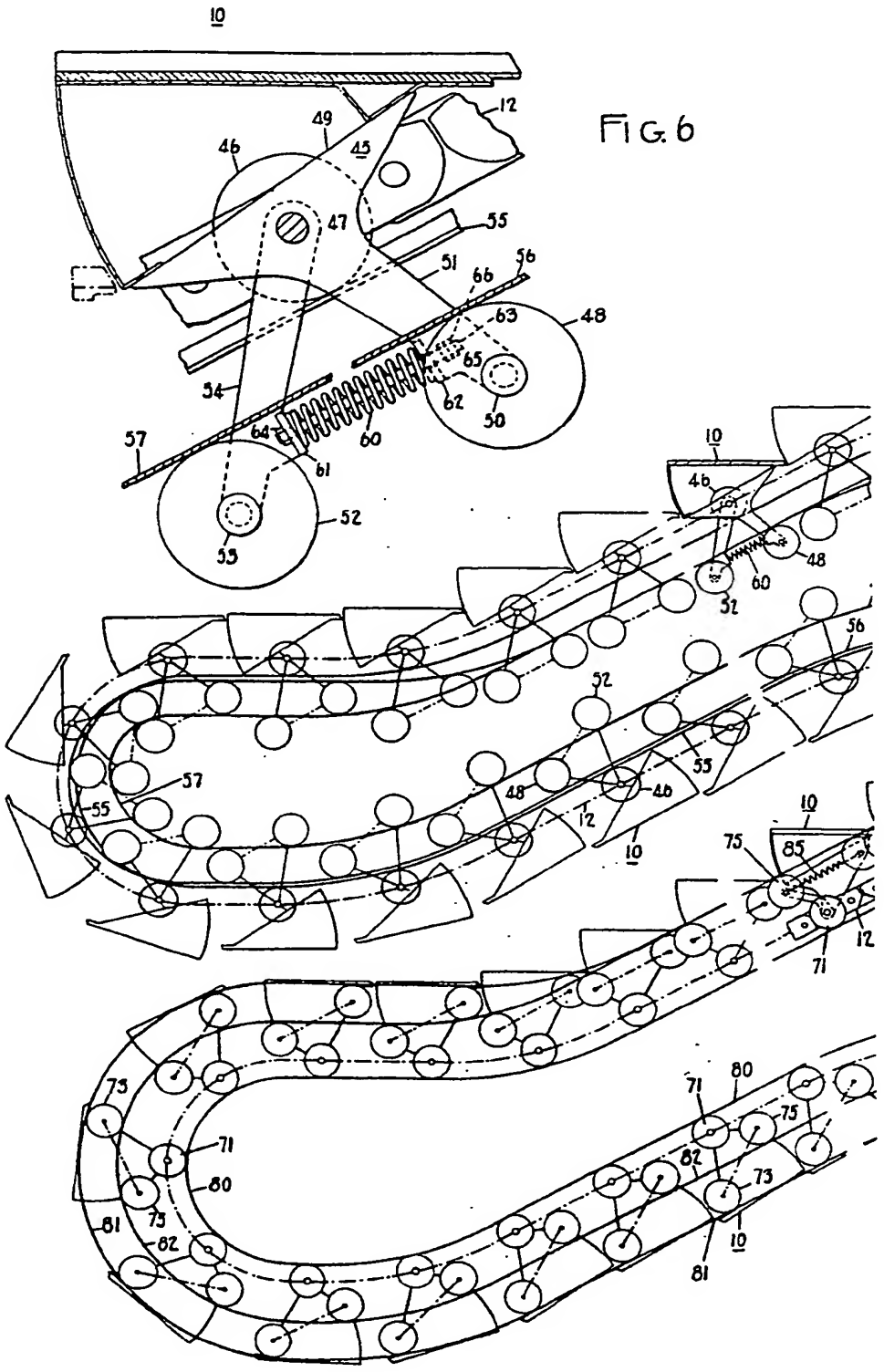

Fig. 6

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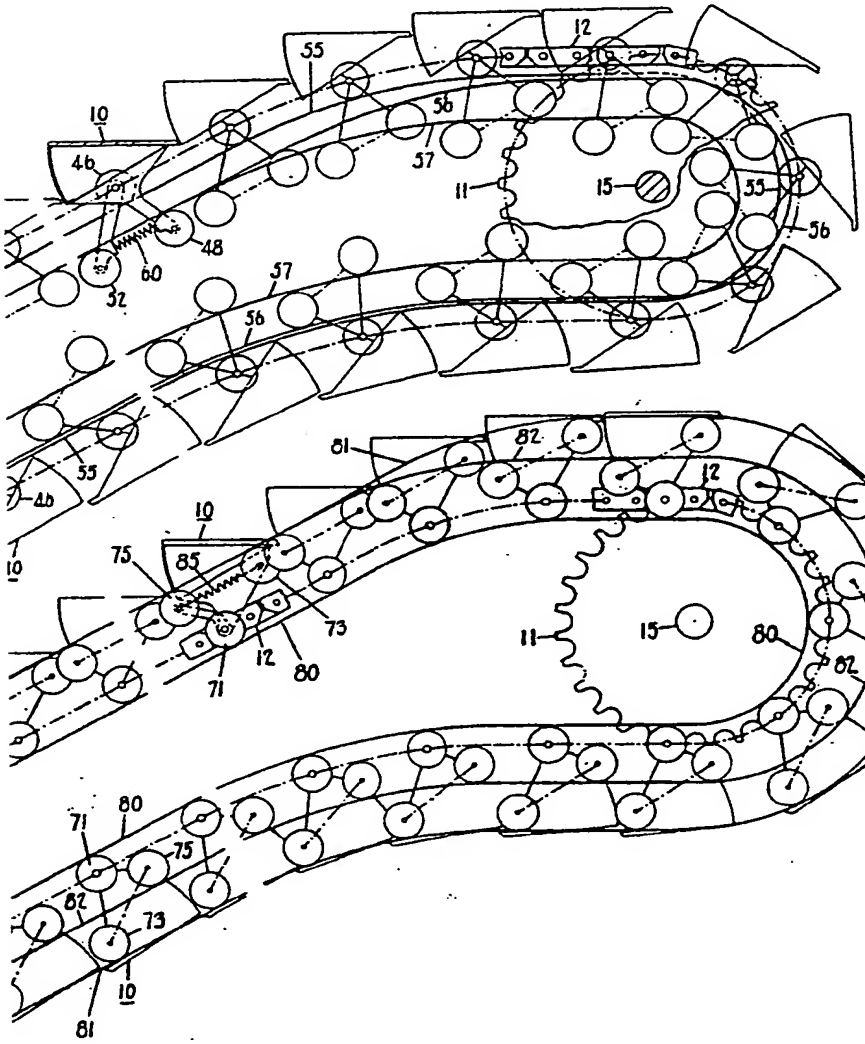

Fig. 4

Fig. 7

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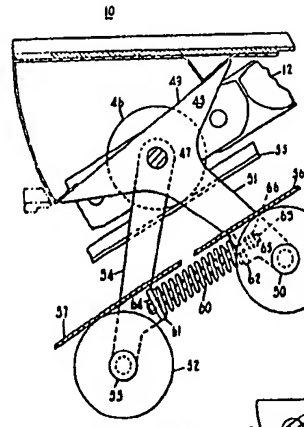

Fig. 6

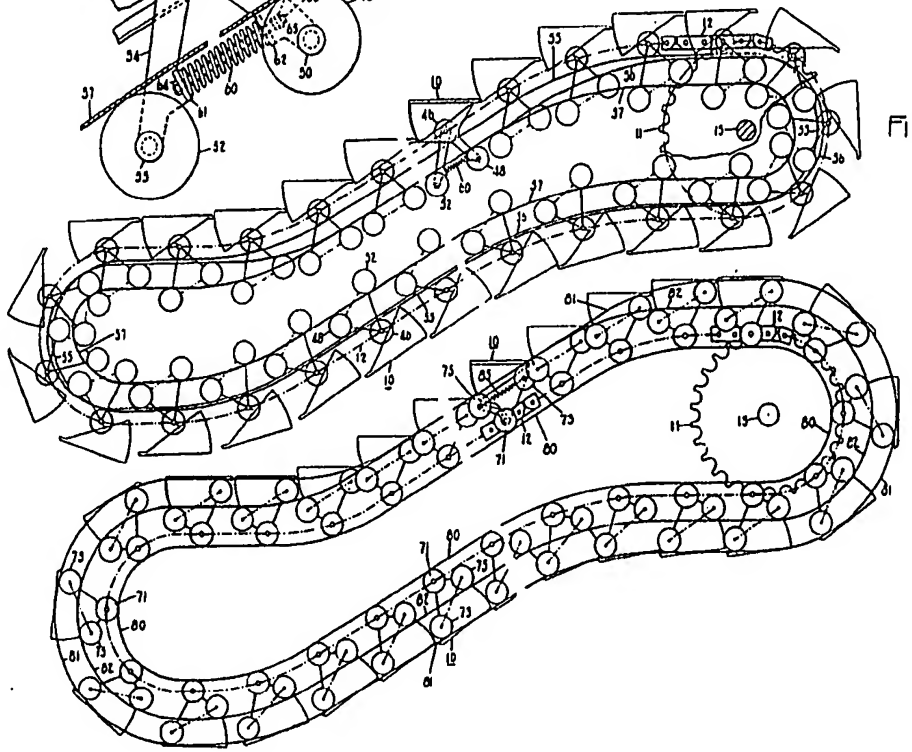

Fig. 4

Fig. 7

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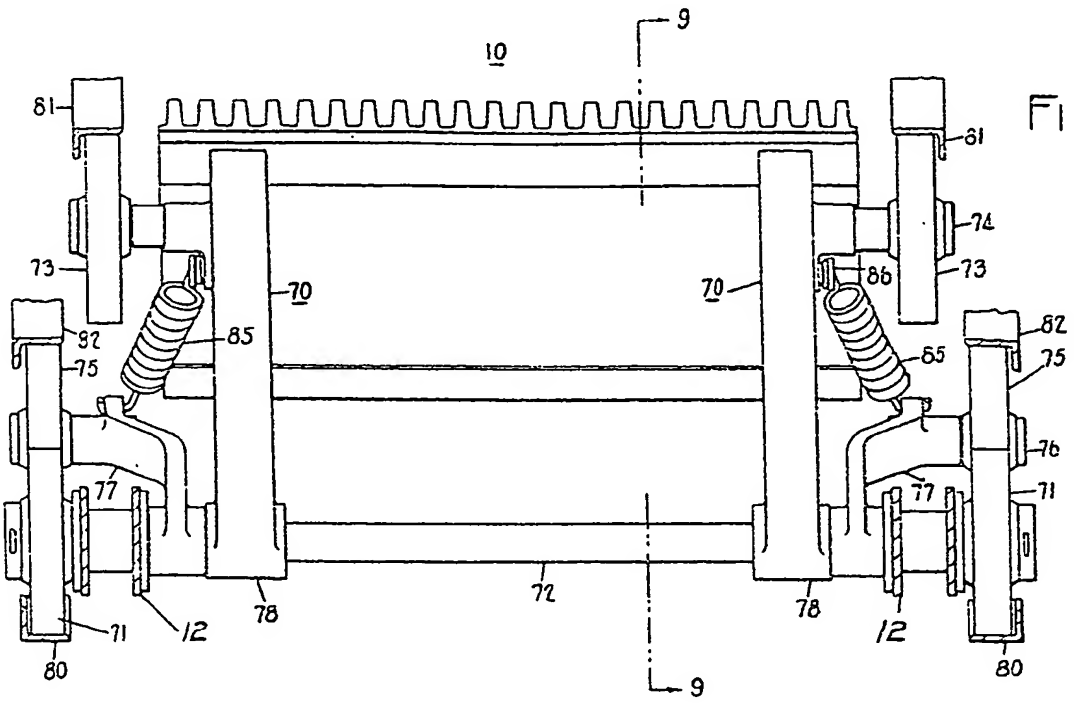


FIG.

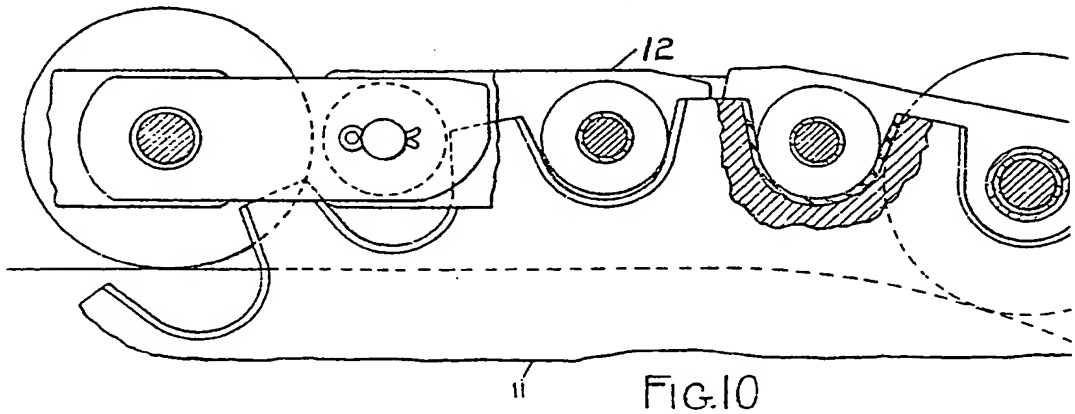


FIG.10

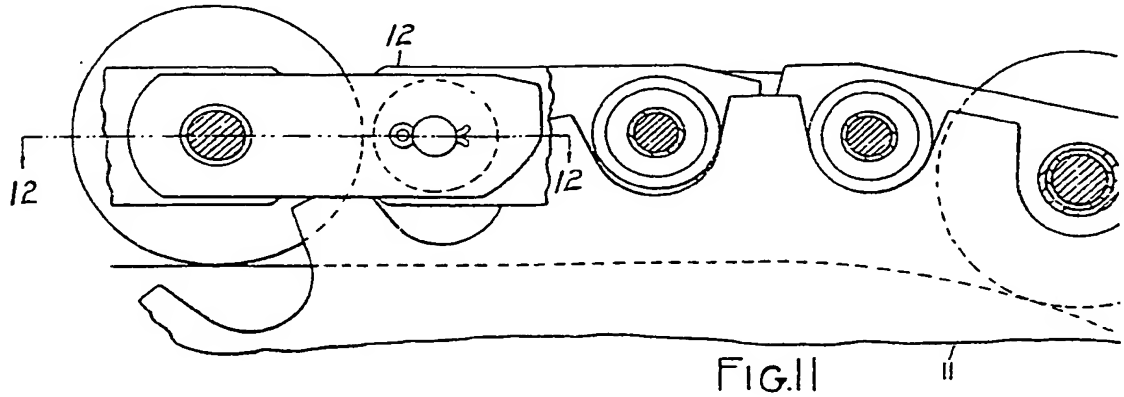


FIG.11

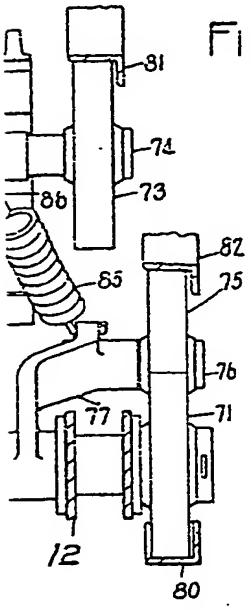


FIG. 8

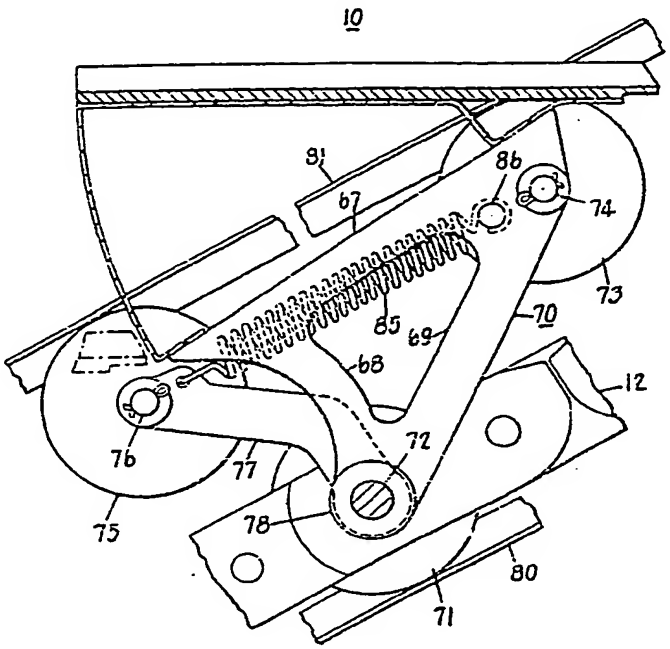
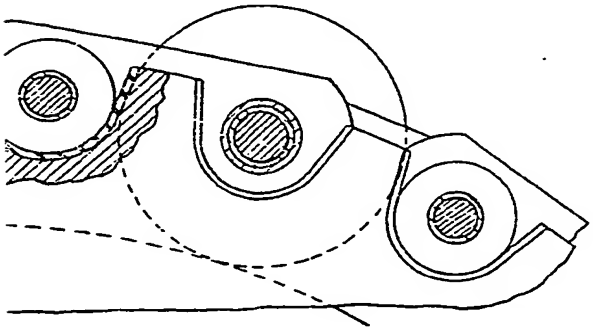
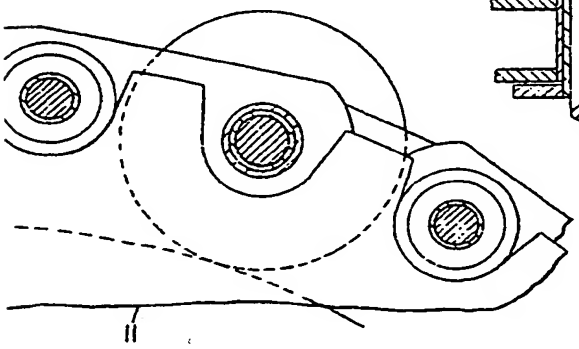


FIG. 9





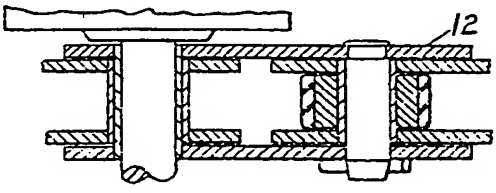


FIG. 12

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491,301 COMPLETE SPECIFICATION

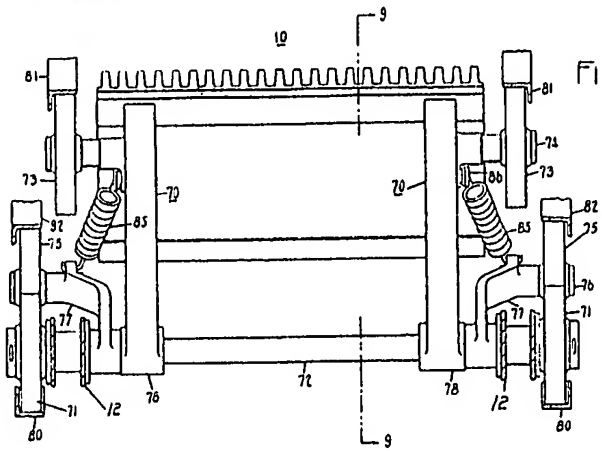

FIG. 8

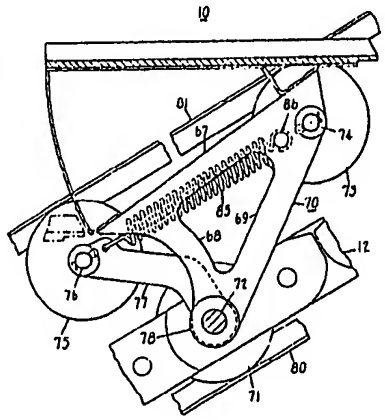

FIG. 9

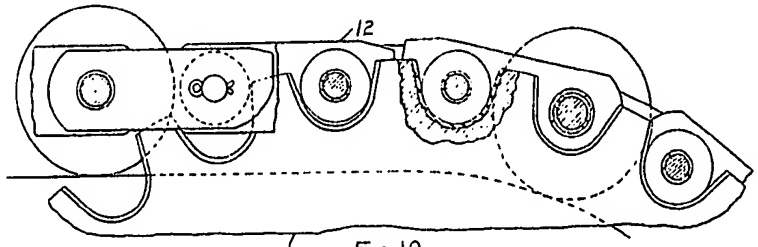

FIG. 10

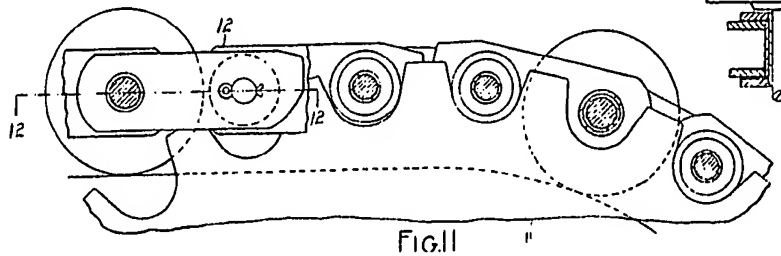

FIG. 11

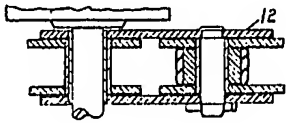

FIG. 12

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